

## CLAIMS

What is claimed is:

1. An automatic power control system for simultaneously adjusting an output power and an extinction ration of a laser diode comprising:
  - bias current determination logic including
    - logic for determining an average power difference between a current measurement of an output power of the laser diode and a reference average output power, and
    - a first integrator communicatively coupled to receive the determined average power difference from the logic, the first integrator summing the determined average power difference with a determined average power difference based on at least one previous measurement resulting in a bias current output signal; and
  - modulation current determination logic including
    - a nonlinear processing block including logic for determining an absolute value of the current measurement adjusted by a nonlinear estimation reference constant, logic, communicatively coupled to the nonlinear processing block for determining a power variance difference between the determined absolute value and a reference power output variance proportional to an extinction ratio  $P_1/P_0$  for reference power levels  $P_1$  and  $P_0$  wherein  $P_1$  represents a digital one value and  $P_0$  represents a digital zero value, and

20                   a second integrator, communicatively coupled to receive the variance  
21 difference from the logic, the second integrator summing the determined variance  
22 difference with a determined power variance difference for at least one previous  
23 measurement resulting in a modulation current output signal.

1     2.       The system of claim 1 wherein the bias current determination logic further  
2 comprises a low pass filter for filtering high frequency noise from a current measurement  
3 value, the low pass filter being communicatively coupled for receiving the current  
4 measurement value and for sending a filtered measurement value to the logic for  
5 determining an average power difference.

1     3.       The system of claim 1 wherein the modulation current determination logic further  
2 comprises a low pass filter for filtering high frequency noise from the absolute value  
3 difference, the low pass filter being communicatively coupled for receiving the absolute  
4 value difference and sending a filtered signal to the logic for determining a power  
5 variance difference.

1     4.       The system of claim 1 wherein the system is implemented in a digital signal  
2 processor chip.

1     5.       A method for maintaining a laser output signal about a reference average output  
2 power and about a reference extinction ratio comprising:  
3               determining a bias current and a modulation current of a laser diode drive current  
4 for a reference  $P_1$  power level and for a reference  $P_0$  power level;  
5               determining a reference average power and a reference power variance based  
6 upon the reference power levels  $P_1$  and  $P_0$ ; and

adjusting the bias current and the modulation current simultaneously for  
maintaining about the reference average power and about the reference extinction ratio.

6. The method of claim 5 wherein determining a bias current and a modulation  
current of a laser diode drive current for the reference  $P_1$  power level and for the  
reference  $P_0$  power level further comprises:

determining the bias current corresponding to the reference  $P_0$  power  
level;

determining the bias current corresponding to the reference  $P_1$  power  
level; and

determining the modulation current corresponding to the reference  $P_1$   
power level as the difference between the bias current for the reference  $P_1$  power  
level and the bias current for the reference  $P_0$  power level.

7. The method of claim 5 wherein determining a reference average power and a  
reference power variance based upon the reference power levels  $P_1$  and  $P_0$  further  
comprises:

producing an optical power swing from reference  $P_0$  to reference  $P_1$  over a  
parameter estimation time period;

integrating measurement output power values received during the parameter  
estimation time period resulting in a bias reference current representing the reference  
average power; and

integrating absolute power values of the received measurement output power  
values adjusted for nonlinear estimation during the parameter estimation time period  
resulting in a modulation reference current representing the reference power variance.

1 8. The method of claim 7 wherein integrating measurement output power values  
2 received during the parameter estimation time period resulting in a bias reference current  
3 representing the reference average power further comprises  
4 responsive to being within the parameter estimation time period, summing  
5 the current measurement with a feedback component including at least one previous  
6 measurement value.

1 9. The method of claim 8 wherein integrating absolute power values of the received  
2 measurement output power values adjusted for nonlinear estimation during the parameter  
3 estimation time period resulting in a modulation reference current representing the  
4 reference power variance further comprises  
5 responsive to being within the parameter estimation time period, summing  
6 the absolute value of the current measurement adjusted for nonlinear estimation with a  
7 feedback component including at least one absolute value of a previous measurement  
8 value adjusted for nonlinear estimation.

1 10. The method of claim 5 wherein adjusting the bias current and the modulation  
2 current simultaneously for maintaining about the reference average power and about the  
3 reference extinction ratio further comprises  
4 receiving a current measured output value;  
5 determining a variation of the measured output power from the reference  
6 average output power;  
7 integrating the variation of the measured output power value with a first  
8 feedback component comprising at previously determined variation based on a previously  
9 measured output power;

10                    setting the bias current output based on the result of the integration of the  
11                    variation of the measured output power with a first feedback component;  
12                    adjusting for nonlinear estimation of the measured output power value;  
13                    determining a variation in an extinction ratio based upon the measured  
14                    output power value from a reference extinction ratio;  
15                    integrating the variation in the extinction ratio based upon the measured  
16                    output power value with a second feedback component comprising at least one  
17                    previously determined variation in the extinction ratio based on a previously  
18                    measured output power value; and  
19                    setting the modulation current output based on the result of the integration  
20                    of the variation in the extinction ratio based upon the measured output power  
21                    value with a second feedback component.

1    11.    A system for maintaining a laser output signal about a reference average output  
2    power and about a reference extinction ratio comprising:  
3                    means for determining a bias current and a modulation current of a laser diode  
4    drive current for a reference  $P_1$  power level and for a reference  $P_0$  power level;  
5                    means for determining a reference average power and a reference power variance  
6    based upon the reference power levels  $P_1$  and  $P_0$ ; and  
7                    means for adjusting the bias current and the modulation current simultaneously  
8    for maintaining about the reference average power and about the reference extinction  
9    ratio.

12. The system of claim 11 wherein the means for determining a bias current and a modulation current of a laser diode drive current for the reference  $P_1$  power level and for the reference  $P_0$  power level further comprises:

means for determining the bias current corresponding to the reference  $P_0$  power level;

means for determining the bias current corresponding to the reference  $P_1$  power level; and

means for determining the modulation current corresponding to the reference  $P_1$  power level as the difference between the bias current for the reference  $P_1$  power level and the bias current for the reference  $P_0$  power level.

13. The system of claim 11 wherein the means for determining a reference average power and a reference power variance based upon the reference power levels  $P_1$  and  $P_0$  further comprises:

means for producing an optical power swing from reference  $P_0$  to reference  $P_1$  over a parameter estimation time period;

means for integrating measurement output power values received during the parameter estimation time period resulting in a bias reference current representing the reference average power; and

means for integrating absolute power values of the received measurement output power values adjusted for nonlinear estimation during the parameter estimation time period resulting in a modulation reference current representing the reference power variance.

1 14. The system of claim 13 wherein the means for integrating measurement output  
2 power values received during the parameter estimation time period resulting in a bias  
3 reference current representing the reference average power further comprises  
4 responsive to being within the parameter estimation time period, means  
5 for summing the current measurement with a feedback component including at least one  
6 previous measurement value.

1 15. The system of claim 14 wherein the means for integrating absolute power values  
2 of the received measurement output power values adjusted for nonlinear estimation  
3 during the parameter estimation time period resulting in a modulation reference current  
4 representing the reference power variance further comprises  
5 responsive to being within the parameter estimation time period, means  
6 for summing the absolute value of the current measurement adjusted for nonlinear  
7 estimation with a feedback component including at least one absolute value of a previous  
8 measurement value adjusted for nonlinear estimation.

1 16. The system of claim 11 wherein the means for adjusting the bias current and the  
2 modulation current simultaneously for maintaining about the reference average power  
3 and about the reference extinction ratio further comprises  
4 means for receiving a current measured output value;  
5 means for determining a variation of the measured output power from the  
6 reference average output power;  
7 means for integrating the variation of the measured output power value  
8 with a first feedback component comprising at previously determined variation based on  
9 a previously measured output power;

10 means for setting the bias current output based on the result of the  
11 integration of the variation of the measured output power with a first feedback  
12 component;  
13 means for adjusting for nonlinear estimation of the measured output power  
14 value;  
15 means for determining a variation in an extinction ratio based upon the  
16 measured output power value from a reference extinction ratio;  
17 means for integrating the variation in the extinction ratio based upon the  
18 measured output power value with a second feedback component comprising at  
19 least one previously determined variation in the extinction ratio based on a  
20 previously measured output power value; and  
21 means for setting the modulation current output based on the result of the  
22 integration of the variation in the extinction ratio based upon the measured output  
23 power value with a second feedback component.

1 17. A computer-usable medium comprising instructions for causing a processor to  
2 execute a method for maintaining a laser output signal about a reference average output  
3 power and about a reference extinction ratio, the method comprising:  
4 determining a bias current and a modulation current of a laser diode drive current  
5 for a reference  $P_1$  power level and for a reference  $P_0$  power level;  
6 determining a reference average power and a reference power variance based  
7 upon the reference power levels  $P_1$  and  $P_0$ ; and  
8 adjusting the bias current and the modulation current simultaneously for  
9 maintaining about the reference average power and about the reference extinction ratio.